US010157507B2

(12) **United States Patent**
Kumar et al.

(10) **Patent No.: US 10,157,507 B2**
(45) **Date of Patent: Dec. 18, 2018**

(54) **VEHICLE MAINTENANCE USING IDENTIFICATION TAGS AND ONBOARD DATA PROCESSING SYSTEM**

(71) Applicant: **The Boeing Company**, Chicago, IL (US)

(72) Inventors: **Anil Kumar**, Sammamish, WA (US); **Kevin Yong Ung**, Bellevue, WA (US)

(73) Assignee: **The Boeing Company**, Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/223,496**

(22) Filed: **Mar. 24, 2014**

(65) **Prior Publication Data**

US 2015/0269787 A1 Sep. 24, 2015

(51) **Int. Cl.**
G07C 5/00 (2006.01)
G07C 5/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G07C 5/00*** (2013.01); ***G07C 5/006*** (2013.01); ***G07C 5/0825*** (2013.01); *G07C 2205/02* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,064,668	B2	6/2006	Porad	
7,068,170	B2	6/2006	Green	
7,545,274	B2 *	6/2009	Coop	G06Q 10/06 340/524
7,551,086	B2 *	6/2009	Coop	G06Q 50/30 340/457.4
7,589,636	B2	9/2009	Ayyagari et al.	
7,598,868	B2	10/2009	Lee et al.	
7,621,193	B2	11/2009	Fay et al.	
8,130,081	B2	3/2012	Ung et al.	
8,231,062	B1	7/2012	Ayyagari et al.	
8,237,548	B2	8/2012	Fay et al.	
8,321,083	B2 *	11/2012	Beebe	G06F 11/0739 701/120
8,384,521	B2	2/2013	Matsen et al.	
8,823,554	B2 *	9/2014	Yourkowski	G06Q 10/00 235/385

(Continued)

OTHER PUBLICATIONS

Coop et al., "Maintaining the Airworthiness Configuration of Aircraft," U.S. Appl. No. 13/664,121, filed Oct. 30, 2012, 44 pages.

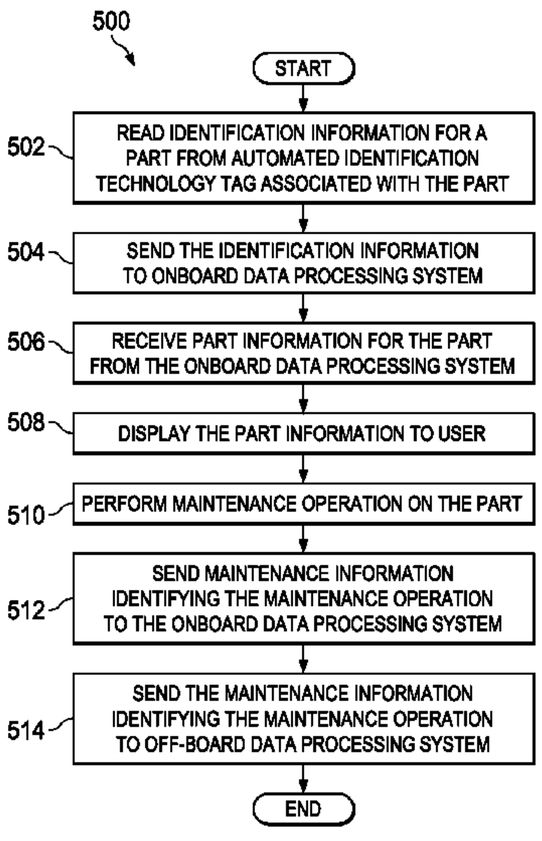
(Continued)

Primary Examiner — Redhwan K Mawari
Assistant Examiner — Edward Torchinsky
(74) *Attorney, Agent, or Firm* — Yee & Associates, P.C.

(57) **ABSTRACT**

A method and apparatus for maintaining a vehicle. Identification information for a part on the vehicle is read from an automated identification technology tag, wherein the automated identification technology tag is on the vehicle and associated with the part. Part information for the part is retrieved from an onboard data processing system on the vehicle using the identification information for the part. The part information retrieved from the onboard data processing system may be displayed to a user. The part information stored onboard the vehicle may be synchronized with an off-board system.

19 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

8,991,692	B2 *	3/2015	Kumar	G06F 17/30011 235/375
2004/0024501	A1 *	2/2004	Muehl	G06Q 10/06 701/29.4
2010/0085165	A1	4/2010	Villa et al.	
2011/0169613	A1	7/2011	Chen et al.	
2012/0044092	A1	2/2012	Shore et al.	
2012/0118946	A1	5/2012	Koreis et al.	
2012/0146815	A1	6/2012	Yourkowski et al.	
2014/0210598	A1 *	7/2014	Mitchell	G06K 19/0701 340/10.5

OTHER PUBLICATIONS

Coop et al., "Aircraft Rework Management," U.S. Appl. No. 13/644,827, filed Oct. 4, 2012, 42 pages.

Knox et al., "Aircraft Interior Component Maintenance," U.S. Appl. No. 13/782,475, filed Mar. 1, 2013, 47 pages.

Kumar et al., "Managing Component Information during Component Lifecycle," U.S. Appl. No. 13/914,294, Jun. 10, 2013, 37 pages.

Shore et al., "Aircraft Equipment Management System," U.S. Appl. No. 13/281,896, filed Oct. 26, 2011, 79 pages.

* cited by examiner

FIG. 1

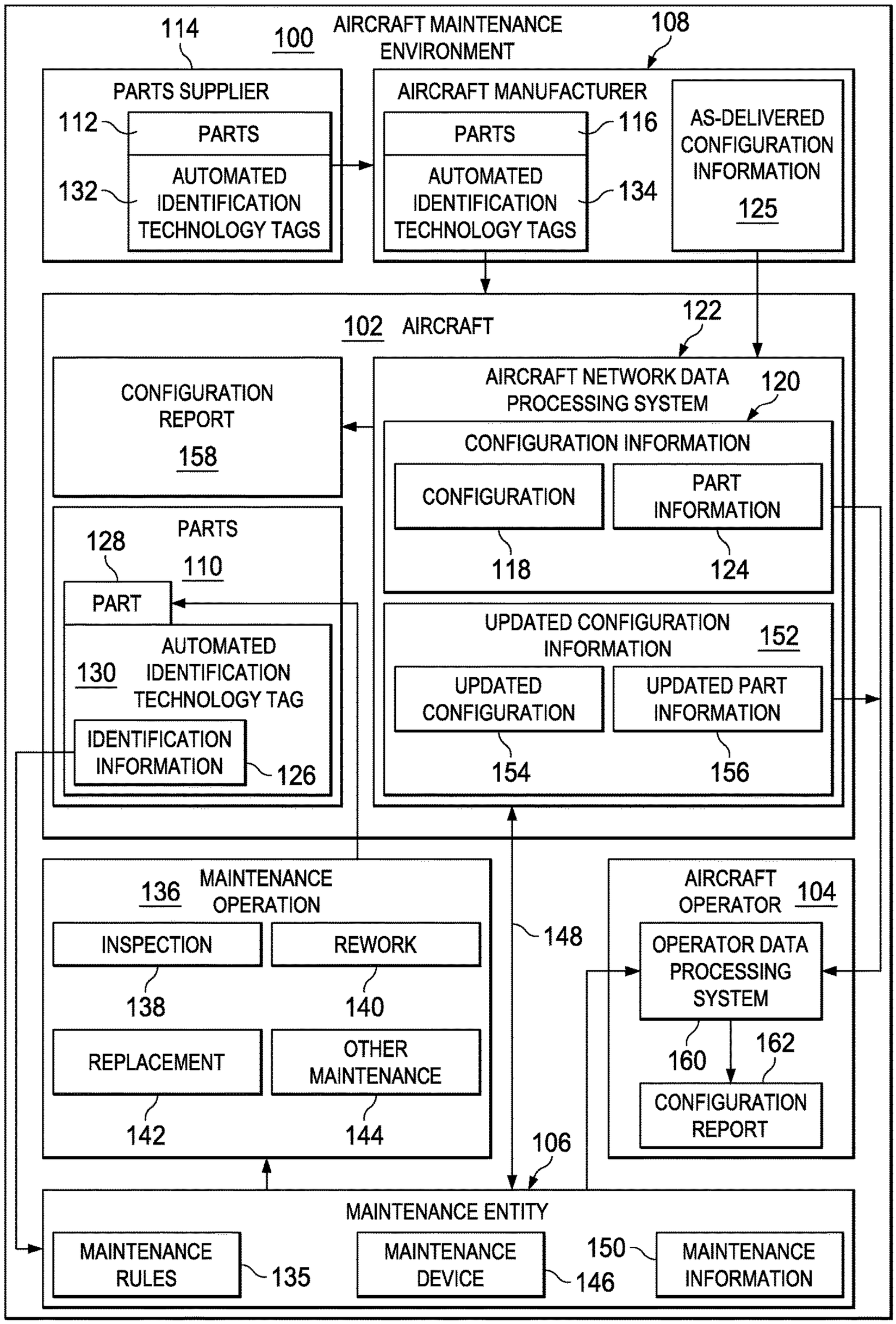

114
100
AIRCRAFT MAINTENANCE ENVIRONMENT
108
PARTS SUPPLIER
112
PARTS
132
AUTOMATED IDENTIFICATION TECHNOLOGY TAGS
AIRCRAFT MANUFACTURER
PARTS
116
AUTOMATED IDENTIFICATION TECHNOLOGY TAGS
134
AS-DELIVERED CONFIGURATION INFORMATION
125
102 AIRCRAFT
122
AIRCRAFT NETWORK DATA PROCESSING SYSTEM
120
CONFIGURATION REPORT
158
CONFIGURATION INFORMATION
CONFIGURATION
PART INFORMATION
118
124
PARTS
128
110
PART
AUTOMATED IDENTIFICATION TECHNOLOGY TAG
130
IDENTIFICATION INFORMATION
126
UPDATED CONFIGURATION INFORMATION
152
UPDATED CONFIGURATION
UPDATED PART INFORMATION
154
156
136 MAINTENANCE OPERATION
INSPECTION
REWORK
138
140
REPLACEMENT
OTHER MAINTENANCE
142
144
148
AIRCRAFT OPERATOR
104
OPERATOR DATA PROCESSING SYSTEM
160
162
CONFIGURATION REPORT
106
MAINTENANCE ENTITY
MAINTENANCE RULES
135
MAINTENANCE DEVICE
146
150
MAINTENANCE INFORMATION

FIG. 2

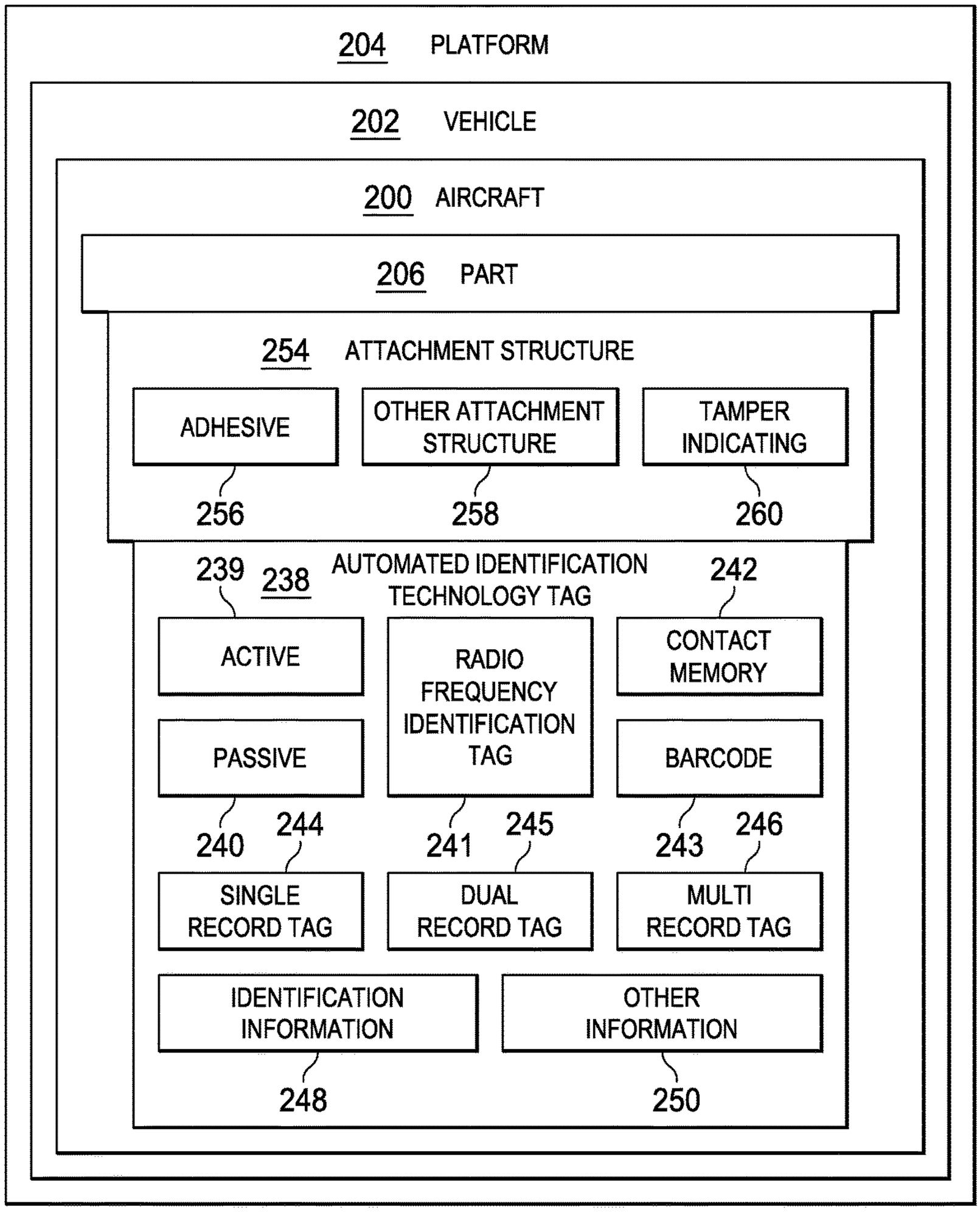

204 PLATFORM
202 VEHICLE
200 AIRCRAFT
206 PART
254 ATTACHMENT STRUCTURE
ADHESIVE
OTHER ATTACHMENT STRUCTURE
TAMPER INDICATING
256
258
260
239
238
AUTOMATED IDENTIFICATION TECHNOLOGY TAG
242
ACTIVE
RADIO FREQUENCY IDENTIFICATION TAG
CONTACT MEMORY
PASSIVE
BARCODE
240
244
241
245
243
246
SINGLE RECORD TAG
DUAL RECORD TAG
MULTI RECORD TAG
IDENTIFICATION INFORMATION
OTHER INFORMATION
248
250

FIG. 3

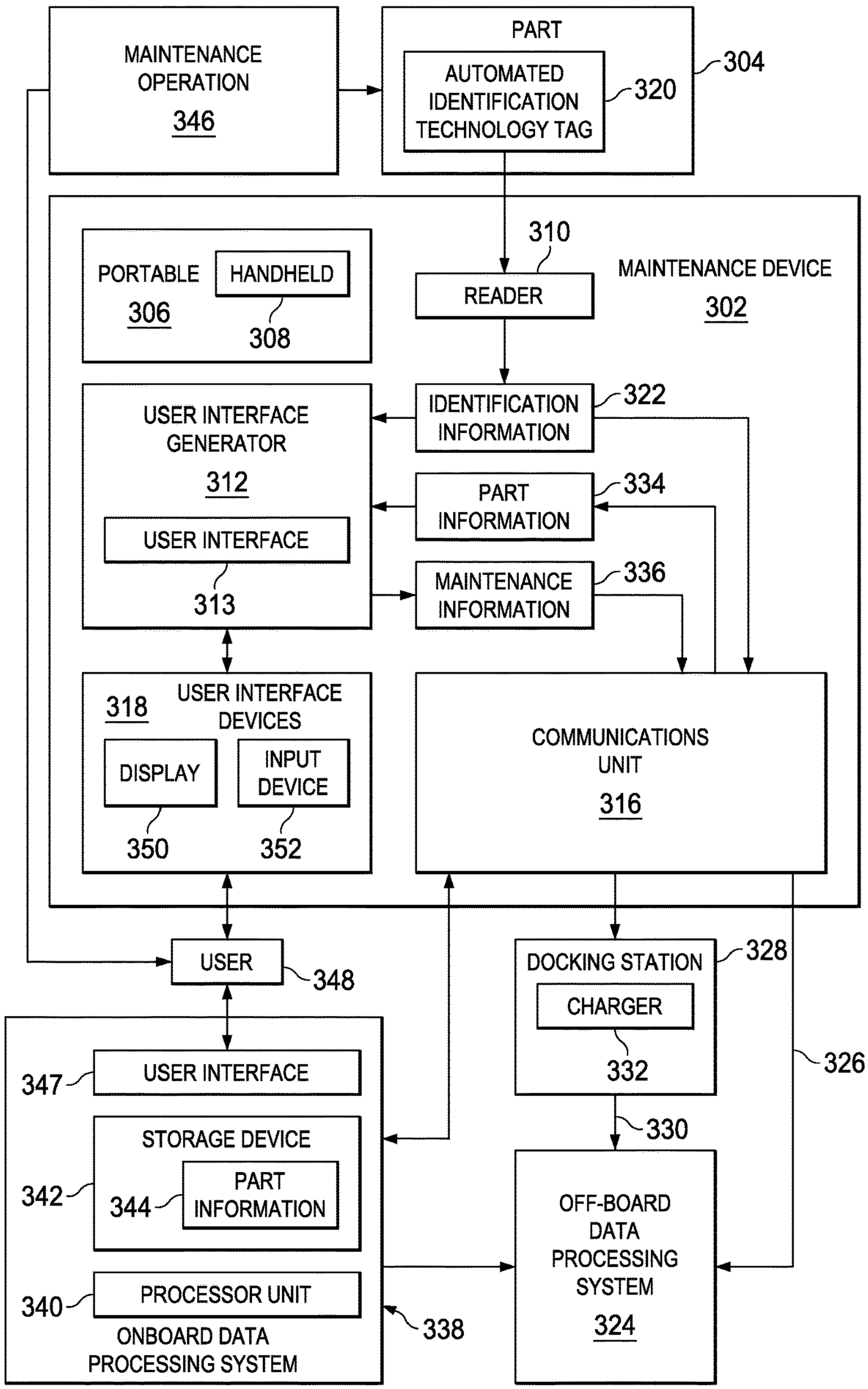

MAINTENANCE OPERATION
346
PART
AUTOMATED IDENTIFICATION TECHNOLOGY TAG
320
304
310
PORTABLE
306
HANDHELD
308
READER
MAINTENANCE DEVICE
302
USER INTERFACE GENERATOR
312
USER INTERFACE
313
IDENTIFICATION INFORMATION
322
PART INFORMATION
334
MAINTENANCE INFORMATION
336
318
USER INTERFACE DEVICES
DISPLAY
350
INPUT DEVICE
352
COMMUNICATIONS UNIT
316
USER
348
DOCKING STATION
CHARGER
332
328
326
330
347
USER INTERFACE
STORAGE DEVICE
342
344
PART INFORMATION
340
PROCESSOR UNIT
ONBOARD DATA PROCESSING SYSTEM
338
OFF-BOARD DATA PROCESSING SYSTEM
324

FIG. 4

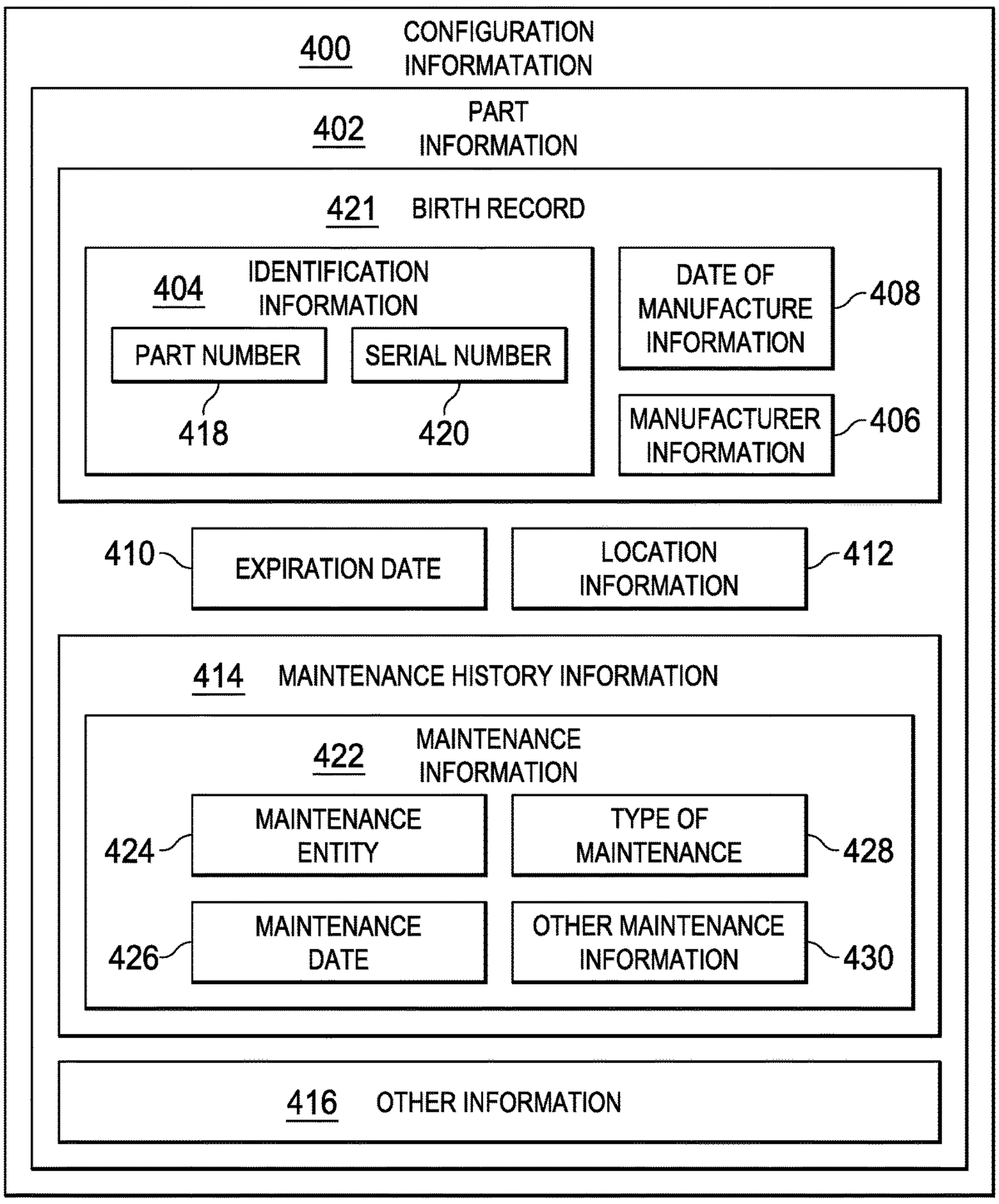

400 CONFIGURATION INFORMATATION
402 PART INFORMATION
421 BIRTH RECORD
404 IDENTIFICATION INFORMATION
PART NUMBER
SERIAL NUMBER
418
420
DATE OF MANUFACTURE INFORMATION
408
MANUFACTURER INFORMATION
406
410
EXPIRATION DATE
LOCATION INFORMATION
412
414 MAINTENANCE HISTORY INFORMATION
422 MAINTENANCE INFORMATION
424
MAINTENANCE ENTITY
TYPE OF MAINTENANCE
428
426
MAINTENANCE DATE
OTHER MAINTENANCE INFORMATION
430
416 OTHER INFORMATION

FIG. 5

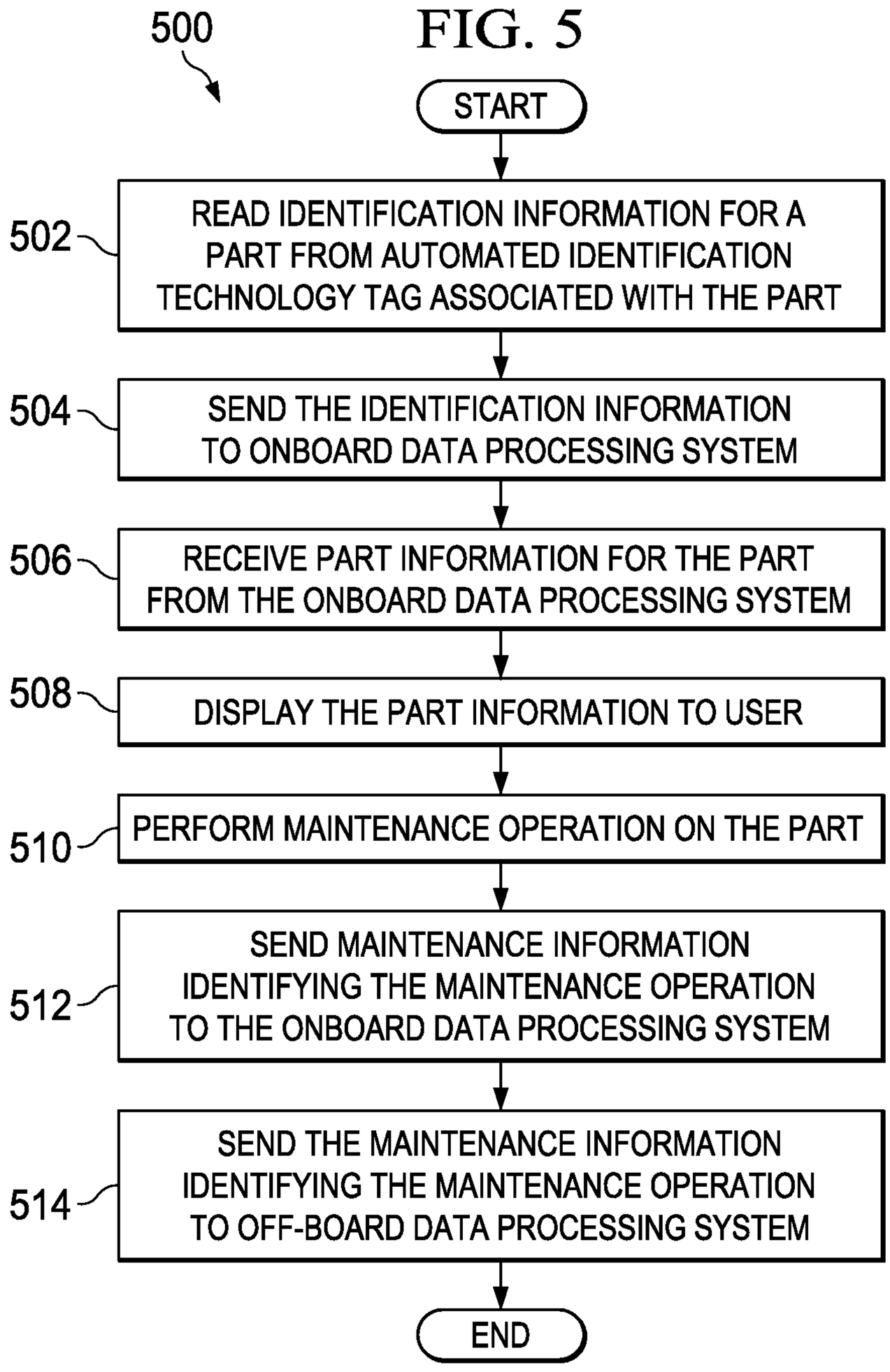

500
START
502
READ IDENTIFICATION INFORMATION FOR A PART FROM AUTOMATED IDENTIFICATION TECHNOLOGY TAG ASSOCIATED WITH THE PART
504
SEND THE IDENTIFICATION INFORMATION TO ONBOARD DATA PROCESSING SYSTEM
506
RECEIVE PART INFORMATION FOR THE PART FROM THE ONBOARD DATA PROCESSING SYSTEM
508
DISPLAY THE PART INFORMATION TO USER
510
PERFORM MAINTENANCE OPERATION ON THE PART
512
SEND MAINTENANCE INFORMATION IDENTIFYING THE MAINTENANCE OPERATION TO THE ONBOARD DATA PROCESSING SYSTEM
514
SEND THE MAINTENANCE INFORMATION IDENTIFYING THE MAINTENANCE OPERATION TO OFF-BOARD DATA PROCESSING SYSTEM
END

FIG. 6

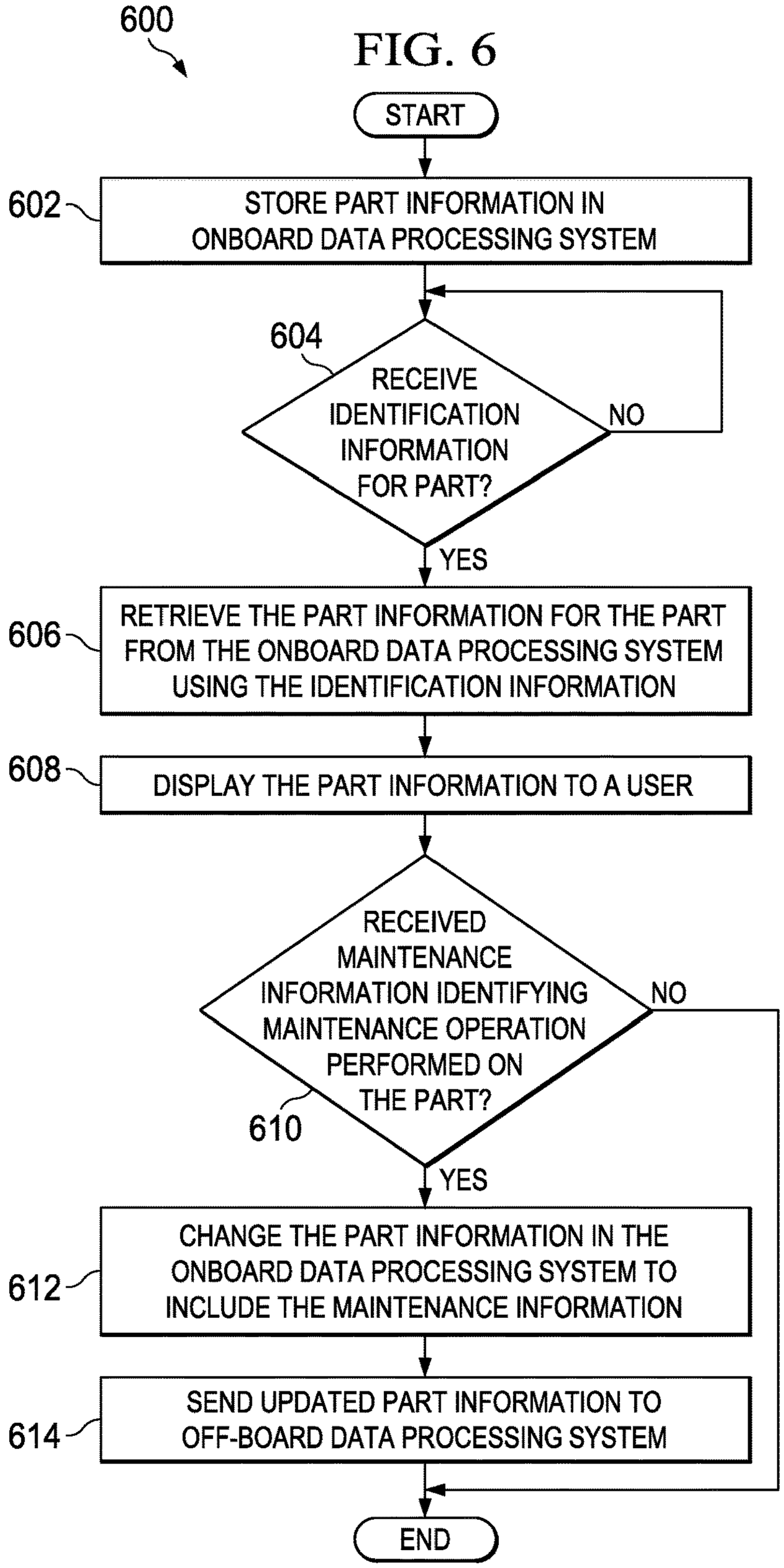
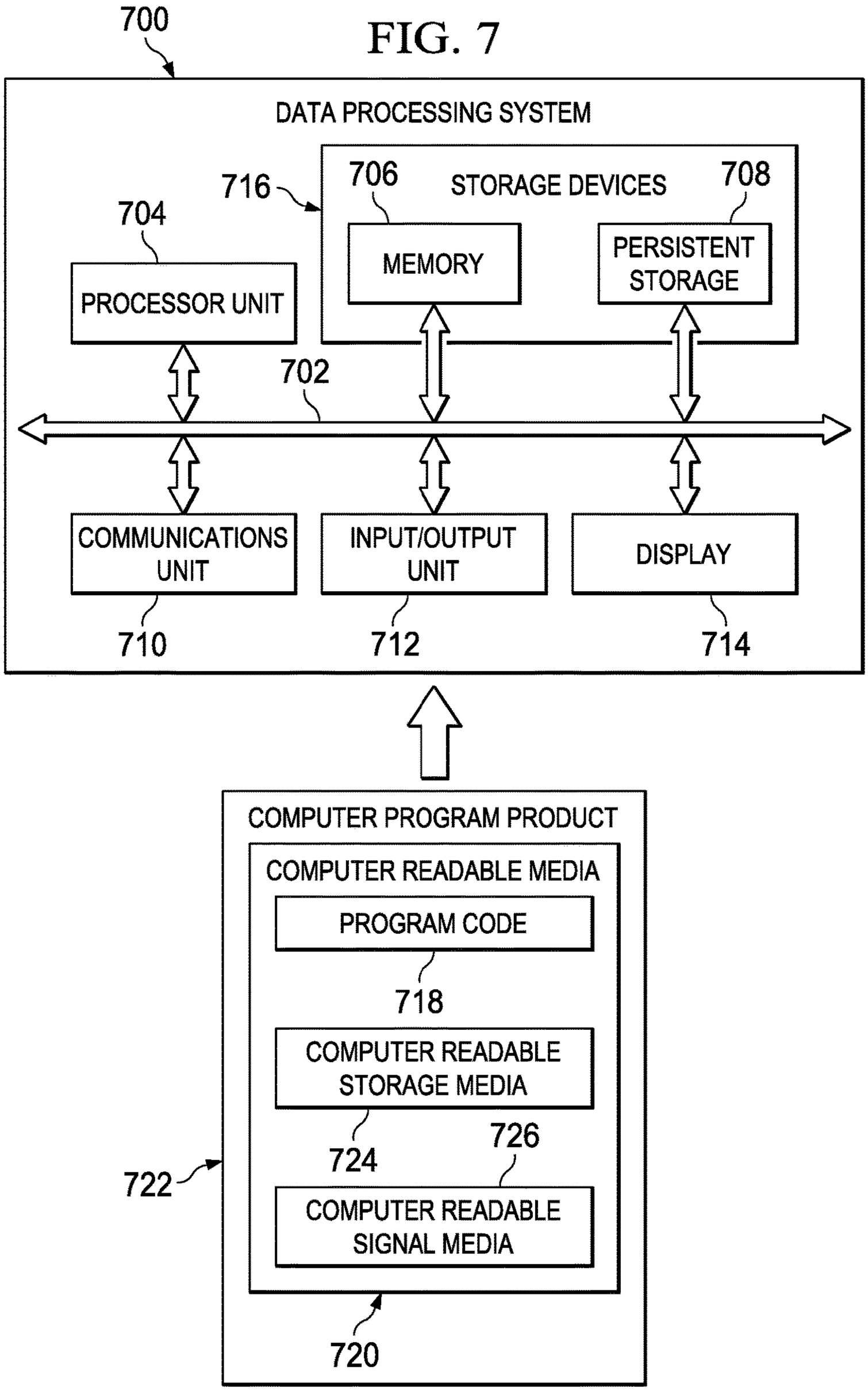

600
START
602
STORE PART INFORMATION IN ONBOARD DATA PROCESSING SYSTEM
604
RECEIVE IDENTIFICATION INFORMATION FOR PART?
NO
YES
606
RETRIEVE THE PART INFORMATION FOR THE PART FROM THE ONBOARD DATA PROCESSING SYSTEM USING THE IDENTIFICATION INFORMATION
608
DISPLAY THE PART INFORMATION TO A USER
610
RECEIVED MAINTENANCE INFORMATION IDENTIFYING MAINTENANCE OPERATION PERFORMED ON THE PART?
NO
YES
612
CHANGE THE PART INFORMATION IN THE ONBOARD DATA PROCESSING SYSTEM TO INCLUDE THE MAINTENANCE INFORMATION
614
SEND UPDATED PART INFORMATION TO OFF-BOARD DATA PROCESSING SYSTEM
END

FIG. 7


700
DATA PROCESSING SYSTEM
716
706
STORAGE DEVICES
708
704
MEMORY
PERSISTENT STORAGE
PROCESSOR UNIT
702
COMMUNICATIONS UNIT
INPUT/OUTPUT UNIT
DISPLAY
710
712
714
COMPUTER PROGRAM PRODUCT
COMPUTER READABLE MEDIA
PROGRAM CODE
718
COMPUTER READABLE STORAGE MEDIA
724
726
722
COMPUTER READABLE SIGNAL MEDIA
720

VEHICLE MAINTENANCE USING IDENTIFICATION TAGS AND ONBOARD DATA PROCESSING SYSTEM

BACKGROUND INFORMATION

1. Field

The present disclosure relates generally to the maintenance of aircraft and other vehicles and managing the configuration of parts of an aircraft. More particularly, the present disclosure relates to a system and method of using automated identification technology tags and a data processing system onboard an aircraft or other vehicle to manage the maintenance of parts of the aircraft or other vehicle.

2. Background

A vehicle may comprise many component parts. For example, a commercial passenger aircraft may comprise thousands of individually identified parts. The many parts of an aircraft comprise the configuration of the aircraft.

An operator of an aircraft, such as an airline or other operator of the aircraft, may desire to know the current configuration of the aircraft. For example, government regulations may require that the current configuration of a commercial passenger aircraft is known by the airline operating the aircraft. An airline or other operator of an aircraft may maintain configuration information that identifies the current configuration of the aircraft. For example, the configuration information may include parts information that identifies the many parts that currently comprise the aircraft. It is desirable that the configuration information is updated accurately and in a timely manner in response to changes in the parts comprising the aircraft, so that the configuration information accurately identifies the current configuration of the aircraft.

Aircraft may be maintained on a regular basis to ensure safe and efficient operation. Aircraft maintenance may include performing various maintenance operations on the various parts of the aircraft. Inspection of parts, reworking of parts, and replacement of parts are examples of maintenance operations that may be performed on the various parts of an aircraft. It is desirable that the configuration information maintained by an airline or other aircraft operator is changed as needed to reflect any changes in the aircraft configuration that may result from performing maintenance operations on the parts of the aircraft.

It may be desirable that an airline or other operator of an aircraft maintains parts information related to the maintenance of the parts of the aircraft. For example, it may be desirable that the parts information includes information identifying various characteristics of the parts of the aircraft that may be useful for maintaining the various parts of the aircraft. It also may be desirable that such parts information is available for use by maintenance personnel and others when needed or desired for performing maintenance operations on the parts of the aircraft or for other purposes.

It may be desirable that parts information for the parts of an aircraft includes maintenance history information identifying maintenance operations that have been performed on the parts. Such maintenance history information may be useful for maintaining the aircraft parts and other purposes. For example, without limitation, maintenance personnel may use such maintenance history information to determine whether a maintenance operation has already been performed on an aircraft part, the nature and extent of any maintenance operations that may have already been performed on the part, when further maintenance of a part is required or desired, what further maintenance may be required or desired to be performed on an aircraft part, or for any other appropriate purpose or combination of purposes related to maintaining an aircraft part. Maintenance history information for the parts on an aircraft also may provide a record of compliance with required or desired aircraft maintenance schedules. In any case, it is desirable that the maintenance history information for the parts of an aircraft is updated accurately and in a timely manner after maintenance operations are performed on the parts.

Automated identification technology tags may be used to automatically identify objects, collect data about the objects, and enter that data directly into a computer system with little or no human involvement. Examples of automated identification technology tags may include radio frequency identification (RFID) tags and contact memory buttons. Automated identification technology tags may be attached to various objects. Information identifying the objects and various characteristics of the objects may be stored in the tags. This information may be read from the tags and automatically entered into a computer system for processing using an appropriate reader device. Such automated identification technology has not been fully utilized for the maintenance of aircraft.

Accordingly, it would be beneficial to have a method and apparatus that take into account one or more of the issues discussed above as well as possibly other issues.

SUMMARY

Illustrative embodiments of the present disclosure provide a method of maintaining a vehicle. Identification information for a part on the vehicle is read from an automated identification technology tag, wherein the automated identification technology tag is on the vehicle and associated with the part. Part information for the part is retrieved from an onboard data processing system on the vehicle using the identification information for the part. The part information retrieved from the onboard data processing system may be displayed to a user.

Illustrative embodiments of the present disclosure also provide an apparatus comprising a user interface on a vehicle, a storage device on the vehicle, and a processor unit on the vehicle. The processor unit on the vehicle is configured to receive identification information for a part on the vehicle from the user interface, retrieve part information for the part from the storage device in response to receiving the identification information for the part, and send the part information retrieved from the storage device to the user interface for display to a user.

Illustrative embodiments of the present disclosure also provide a method of maintaining an aircraft. Configuration information for the aircraft is stored in a storage device in an aircraft network data processing system on the aircraft. The configuration information comprises part information for a part on the aircraft. The part information is retrieved from the storage device by the aircraft network data processing system in response to receiving identification information for the part. The part information is sent by the aircraft network data processing system to a user interface for display to a user. Maintenance information for the part is received by the aircraft network data processing system. The maintenance information identifies a maintenance operation performed on the part. The part information in the storage device is changed by the aircraft network data processing system in response to receiving the maintenance information to form updated configuration information including the maintenance information. The updated configuration infor-

mation is sent to an off-board data processing system that is not on the aircraft by the aircraft network data processing system.

The features, functions, and benefits may be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments in which further details may be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the illustrative embodiments are set forth in the appended claims. The illustrative embodiments, however, as well as a preferred mode of use, further objectives, and features thereof will best be understood by reference to the following detailed description of illustrative embodiments of the present disclosure when read in conjunction with the accompanying drawings, wherein:

FIG. **1** is an illustration of a block diagram of an aircraft maintenance environment in accordance with an illustrative embodiment;

FIG. **2** is an illustration of a block diagram of an aircraft in accordance with an illustrative embodiment;

FIG. **3** is an illustration of a block diagram of a maintenance device in accordance with an illustrative embodiment;

FIG. **4** is an illustration of a block diagram of configuration information in accordance with an illustrative embodiment;

FIG. **5** is an illustration of a flowchart of a process for maintaining a vehicle in accordance with an illustrative embodiment;

FIG. **6** is an illustration of a flowchart of another process for maintaining a vehicle in accordance with an illustrative embodiment; and

FIG. **7** is an illustration of a block diagram of a data processing system in accordance with an illustrative embodiment.

DETAILED DESCRIPTION

The different illustrative embodiments recognize and take into account a number of different considerations. "A number," as used herein with reference to items, means one or more items. For example, "a number of different considerations" means one or more different considerations.

The different illustrative embodiments recognize and take into account that it is desirable to maintain accurate configuration information that identifies the parts of an aircraft or other vehicle and various characteristics of those parts. The different illustrative embodiments recognize and take into account that currently, such configuration information may be maintained on paper. Configuration information that is maintained on paper may be relatively difficult and time consuming to keep up-to-date. For example, without limitation, configuration information that is maintained on paper may be relatively difficult and time consuming to change in response to changes in the parts of the vehicle, to identify maintenance operations performed on the parts, and for other purposes. Furthermore, configuration information that is maintained on paper may be relatively difficult to use and make available for use by maintenance personnel and others. For example, it may be relatively difficult and expensive to make paper copies of the latest configuration information readily available to those who may need or desire to use the information to perform maintenance operations on a vehicle or for other purposes.

The different illustrative embodiments recognize and take into account that configuration information identifying the parts of an aircraft or other vehicle and various characteristics of those parts may be maintained by an operator of the aircraft or other vehicle on an off-board data processing system that is not on the vehicle. For example, without limitation, an airline may maintain such configuration information for an aircraft on an off-board data processing system that is operated by or for the airline at a ground location that is not on the aircraft. The different illustrative embodiments recognize and take into account that access to the configuration information stored in such an off-board data processing system may not always be available when needed or desired. For example, without limitation, it may be desirable to perform maintenance operations on an aircraft or other vehicle at a remote location or under conditions for which an acceptable connection for communications with an off-board data processing system cannot be established. In this case, it may not be possible for maintenance personnel to retrieve configuration information from the off-board data processing system that may be necessary or useful for performing the maintenance operations. Furthermore, in this case, updating the configuration information to include maintenance history information identifying the maintenance operations that were performed may be delayed until an acceptable connection for communications with the off-board data processing system can be established.

The different illustrative embodiments recognize and take into account that part information, including maintenance history information for a part, may be stored on an automated identification technology tag that is attached to the part or otherwise attached to an aircraft or other vehicle and associated with the part on the aircraft or other vehicle. In this case, the part information may be available for use in performing maintenance operations on the aircraft or other vehicle even when acceptable communications between the aircraft or other vehicle and off-board systems cannot be established. The different illustrative embodiments also recognize and take into account, however, that reading information from an automated identification technology tag may require the use of an appropriate reader device. Therefore, maintenance personnel or others may not be able to access the part information stored on an automated identification technology tag on an aircraft or other vehicle if an appropriate reader device is not available.

The different illustrative embodiments also recognize and take into account that writing information to an automated identification technology tag may be relatively more difficult than reading information from an automated identification technology tag. For example, without limitation, maintenance personnel may be able to read part information from an automated identification technology tag for a part on an aircraft or other vehicle for use in performing a maintenance operation on the part. However, the maintenance personnel may experience difficulty in updating the part information stored on the automated identification technology tag to include maintenance information identifying the maintenance operation performed on the part. Moreover, the operator of an aircraft or other vehicle on which automated identification technology tags are used to store part information for the parts of the aircraft or other vehicle may need to implement appropriate access control methods to ensure that only authorized users are able to write information to the automated identification technology tags on the aircraft or other vehicle.

The different illustrative embodiments also recognize and take into account that the amount of maintenance history

information for a part that may be desirable to store on an automated identification technology tag may be unpredictable and may be voluminous in some cases. Therefore, it may be desirable to use automated identification technology tags that are configured to receive and store a relatively large amount of information to store the part information for a part on an aircraft or other vehicle. In this case, it is less likely that there will not be enough storage capacity on an automated identification technology tag associated with a part to store desirable maintenance history information and other information for the part. However, the different illustrative embodiments recognize and take into account that automated identification technology tags that are configured to receive and store more information may be more expensive than automated identification technology tags that are configured to store less information thereon. Therefore, the use of automated identification technology tags that are configured to receive and store a relatively large amount of information thereon for storing part information on a vehicle may significantly increase the cost of a vehicle, such as an aircraft, that has a relatively large number of parts.

The different illustrative embodiments also recognize and take into account that it may be desirable that changes to part information that are stored in automated identification technology tags on an aircraft or other vehicle are reflected in configuration information for the aircraft or other vehicle that is maintained off-board the aircraft or other vehicle. For example, without limitation, an airline may want to ensure that the configuration information for an aircraft that is maintained off-board the aircraft accurately identifies any maintenance operations that may have been performed on the parts of the aircraft. Therefore, the airline may need to develop an appropriate method to synchronize the latest information on all of the automated identification tags for parts of the aircraft with the configuration information for the aircraft that is maintained in an off-board system.

In accordance with an illustrative embodiment, identification information for parts on an aircraft or other vehicle may be stored in automated identification technology tags associated with the parts on the aircraft or other vehicle. More detailed part information for the parts, such as maintenance history information and other information for the parts, may be stored in a data processing system onboard the aircraft or other vehicle. Maintenance personnel or others may read the identification information from an automated identification technology tag for a part using an appropriate maintenance device. The identification information for the part may be used to retrieve the more detailed part information for the part from the onboard data processing system. The more detailed part information may be displayed on the maintenance device and used, for example, to perform a maintenance operation on the part. The maintenance device also may be used to update the part information stored in the onboard data processing system to include, for example, information identifying the maintenance operation performed on the part.

In accordance with an illustrative embodiment, part information that may be necessary or useful for performing maintenance operations on the parts of an aircraft or other vehicle, or for other purposes, may be stored in an onboard data processing system on the aircraft or other vehicle. Such part information may be readily obtained from the onboard data processing system for use on the aircraft or other vehicle. A suitable connection for communication between the aircraft or other vehicle and an off-board system that is not on the aircraft or other vehicle does not need to be established to use the part information stored on the onboard system. Part information stored in the onboard data processing system may be updated, for example, to identify maintenance operations performed on the parts of the aircraft or other vehicle. Therefore, illustrative embodiments may provide complete and up-to-date configuration information for an aircraft or other vehicle on the aircraft or other vehicle. Such up-to-date configuration information may be sent from the onboard data processing system on the aircraft or other vehicle to an off-board data processing system that is not on the aircraft or other vehicle at an appropriate time, when satisfactory communications between the aircraft or other vehicle and the off-board system can be established. Thus, the illustrative embodiments also may provide complete and up-to-date configuration information for an aircraft or other vehicle on an off-board system that is not on the aircraft or other vehicle. For example, without limitation, such an off-board system may be operated by or for an operator of the aircraft or other vehicle.

In accordance with an illustrative embodiment, part information may be retrieved from an onboard data processing system on an aircraft or other vehicle and viewed using an appropriate maintenance device that is configured to read identification information from an automated identification technology tag associated with the part on the aircraft or other vehicle. In this case, the identification information read from the automated identification technology tag for the part may be used to identify the part information for the part in the onboard data processing system that is retrieved and displayed on the maintenance device. The maintenance device also may be used to update the part information for the part that is stored in the onboard data processing system. For example, without limitation, the maintenance device may be used to update the part information stored in the onboard data processing system to include maintenance information identifying a maintenance operation performed on the part. Alternatively, part information may be retrieved from the onboard data processing system, displayed to a user, and updated by a user via a user interface to the onboard data processing system other than the maintenance device. In this case, part information stored on an aircraft or other vehicle may be used and updated when a maintenance device configured to read information from automated identification technology tags associated with the parts on the aircraft or other vehicle is not available.

In accordance with an illustrative embodiment, only identification information for identifying parts of an aircraft or other vehicle may be stored in automated identification technology tags associated with the parts on the aircraft or other vehicle. Such identification information may be locked in the automated identification technology tags such that the identification information stored in the automated identification technology tags cannot be changed by maintenance personnel or others on the aircraft or other vehicle. More detailed and voluminous part information for the parts may be stored in the onboard data processing system on the aircraft or other vehicle. For example, the part information stored in the onboard data processing system may include maintenance history information identifying maintenance operations performed on the parts. Because a relatively small amount of identity information may be stored on the automated identification technology tags and the information that is stored on the automated identification technology tags need not be changed on the aircraft or other vehicle, relatively inexpensive automated identification technology tags may be used. Furthermore, difficulties associated with writing information to automated identification technology tags and the need to provide access controls to prevent

unauthorized writing to automated identification technology tags on the aircraft or other vehicle may be avoided.

Turning now to FIG. **1**, an illustration of a block diagram of an aircraft maintenance environment is depicted in accordance with an illustrative embodiment. In this illustrative example, aircraft maintenance environment **100** comprises aircraft **102**. For example, without limitation, aircraft **102** may include any type of commercial, military, or other aircraft.

Aircraft **102** in aircraft maintenance environment **100** may be operated by aircraft operator **104**. For example, without limitation, aircraft operator **104** may be an airline, military or other government entity, or any other operator of aircraft **102**.

Aircraft **102** may be maintained in aircraft maintenance environment **100** by maintenance entity **106**. Maintenance entity **106** may be any entity for maintaining aircraft **102**. For example, without limitation, maintenance entity **106** may be aircraft operator **104** or an entity employed by aircraft operator **104** to maintain aircraft **102**. For example, without limitation, maintenance entity **106** may include aircraft manufacturer **108**.

Aircraft **102** may comprise parts **110**. Parts **110** also may be referred to as components of aircraft **102**. Aircraft manufacturer **108** may assemble parts **110** to form aircraft **102**. For example, without limitation, parts **110** of aircraft **102** may include parts **112** provided by parts supplier **114**. Parts **112** may be provided from parts supplier **114** to aircraft manufacturer **108**. Aircraft manufacturer **108** may provide parts **116** for aircraft **102**. Aircraft manufacturer **108** may combine parts **112** from parts supplier **114** along with parts **116** provided by aircraft manufacturer **108** to form parts **110** of aircraft **102**. Parts **110** of aircraft **102** also may include parts **110** from other sources. For example, without limitation, parts **110** of aircraft **102** may include parts **110** provided by aircraft operator **104**, from another appropriate source, or from various combinations of sources.

Parts **110** forming aircraft **102** define configuration **118** of aircraft **102**. It may be desirable that configuration **118** of aircraft **102** is known. For example, without limitation, government regulations may require aircraft operator **104** to keep appropriate records identifying configuration **118** of aircraft **102**. It may be desirable for maintenance entity **106** to know configuration **118** of aircraft **102** to maintain aircraft **102** in an effective and efficient manner.

In accordance with an illustrative embodiment, configuration **118** of aircraft **102** may be identified by configuration information **120** stored onboard aircraft **102**. For example, without limitation, configuration information **120** may be stored in aircraft network data processing system **122** or in another appropriate system or device on aircraft **102**. Aircraft network data processing system **122** also may be referred to as an onboard network system on aircraft **102**. For example, without limitation, configuration information **120** may be stored in an appropriate storage device that is part of or connected to aircraft network data processing system **122**.

Configuration information **120** may include part information **124**. Part information **124** may include any appropriate information regarding parts **110** of aircraft **102** that comprise configuration **118** of aircraft **102**. Part information **124** may include information identifying various characteristics of parts **110** of aircraft **102**. Part information **124** may be used for various purposes on aircraft **102**. For example, without limitation, part information **124** may be used by maintenance entity **106** to perform maintenance on parts **110** of aircraft **102**.

As-delivered configuration information **125** may identify configuration **118** of aircraft **102** at the time that aircraft **102** is delivered from aircraft manufacturer **108** to aircraft operator **104**. For example, without limitation, as-delivered configuration information **125** may include part information **124** for parts **110** of aircraft **102** as delivered from aircraft manufacturer **108** to aircraft operator **104**. As-delivered configuration information **125** may comprise the initial configuration information **120** stored onboard aircraft **102**. For example, without limitation, as-delivered configuration information **125** may be stored in aircraft network data processing system **122** or elsewhere on aircraft **102** by aircraft manufacturer **108** before aircraft **102** is delivered by aircraft manufacturer **108** to aircraft operator **104**. Alternatively, as-delivered configuration information **125** may be delivered to aircraft **102** and stored in aircraft network data processing system **122** or elsewhere on aircraft **102** in any appropriate manner and by any appropriate entity after aircraft **102** is delivered by aircraft manufacturer **108** to aircraft operator **104**.

In accordance with an illustrative embodiment, identification information **126** for part **128** on aircraft **102** may be stored on automated identification technology tag **130** associated with part **128** on aircraft **102**. Part **128** may be one of parts **110** of aircraft **102**. Automated identification technology tag **130** may be, for example, a radio frequency identification tag, a contact memory, a bar code, or any other appropriate automated identification technology tag. Automated identification technology tag **130** may be attached to part **128** or otherwise associated with part **128** on aircraft **102**. For example, without limitation, automated identification technology tag **130** may be associated with part **128** on aircraft **102** by being attached to aircraft **102** at a location near part **128** on aircraft **102**.

Identification information **126** for part **128** may be stored on automated identification technology tag **130** on aircraft **102** in any appropriate manner. For example, without limitation, automated identification technology tags **132** may be attached to parts **112** by parts supplier **114**. In this case, identification information for parts **112** may be stored on automated identification technology tags **132** by parts supplier **114** before parts **112** are delivered to aircraft manufacturer **108**. Alternatively, or in addition, aircraft manufacturer **108** may store identification information for parts **112** from parts supplier **114** on automated identification technology tags **132** attached to parts **112** by parts supplier **114**. As another example, automated identification technology tags **134** may be attached by aircraft manufacturer **108** to parts **112** provided by parts supplier **114**, parts **116** provided by aircraft manufacturer **108**, or both. In this case, aircraft manufacturer **108** may store identification information for parts **112** and **116** on automated identification technology tags **132** and **134**, respectively.

As a further example, automated identification technology tag **130** may be attached to part **128** on aircraft **102** or to a location on aircraft **102** near part **128** on aircraft **102** by aircraft manufacturer **108**, maintenance entity **106**, or any other appropriate entity. In this case, identification information **126** for part **128** may be stored on automated identification technology tag **130** by aircraft manufacturer **108**, maintenance entity **106**, or any other appropriate entity. In any case, identification information **126** stored on automated identification technology tag **130** may be locked or otherwise fixed in any appropriate manner such that the ability to change identification information **126** stored on automated identification technology tag **130** on aircraft **102** is reduced or eliminated.

Identification information **126** on automated identification technology tag **130** may include any appropriate information for identifying part **128** on aircraft **102**. Preferably, identification information **126** stored on automated identification technology tag **130** may comprise a relatively small or minimal amount of information for identifying part **128**. For example, without limitation, identification information **126** may comprise a part number for part **128**, a serial number for part **128**, or any other appropriate information or combination of information for identifying part **128** on aircraft **102**. In accordance with an illustrative embodiment, identification information **126** for part **128** on automated identification technology tag **130** may be used to identify and retrieve part information **124** for part **128** that is stored in aircraft network data processing system **122** on aircraft **102**.

Maintenance entity **106** may maintain aircraft **102** in accordance with appropriate maintenance rules **135**. For example, maintenance rules **135** may define various procedures for inspecting and maintaining aircraft **102**. Maintenance rules **135** may define part of a maintenance program for maintaining aircraft **102** in an airworthy condition. Maintenance rules **135** may define various rules for determining whether aircraft **102** is airworthy. Maintenance rules **135** may be developed and provided to maintenance entity **106** from various sources. For example, maintenance rules **135** may include manufacturer instructions for maintaining aircraft **102** that are provided by aircraft manufacturer **108**. For example, without limitation, manufacturer instructions may include instructions for continued airworthiness. These instructions may specify procedures for inspection, maintenance, repair, and replacement of various parts **110** of aircraft **102**. Maintenance rules **135** also may include operator rules provided by aircraft operator **104** for the inspection and maintenance of aircraft **102**. Maintenance rules **135** may be developed by aircraft manufacturer **108**, aircraft operator **104**, another entity, or a combination of entities to satisfy regulations issued by a government agency or other entity with authority to issue regulations regarding the maintenance of aircraft **102**.

In accordance with an illustrative embodiment, maintenance entity **106** may use part information **124** stored in aircraft network data processing system **122** on aircraft **102** to maintain aircraft **102**. For example, maintenance entity **106** may use part information **124** for part **128** stored in aircraft network data processing system **122** on aircraft **102** to perform maintenance operation **136** on part **128**. For example, without limitation, part information **124** for part **128** may include information that may be used by maintenance entity **106** to identify when maintenance operation **136** should be performed on part **128**, what maintenance operation **136** should be performed on part **128**, maintenance operation **136** already performed on part **128**, other information, or various combinations of information that may be necessary or useful for performing maintenance operation **136** on part **128**.

For example, without limitation, maintenance operation **136** may include inspection **138** of part **128**, rework **140** of part **128**, replacement **142** of part **128**, other maintenance **144** of part **128**, or any appropriate combination of maintenance operations that may be performed on part **128**. For example, maintenance entity **106** may perform inspection **138** of part **128** to identify any inconsistencies in part **128** that may affect aircraft **102** in an undesired manner. Maintenance entity **106** may rework **140** part **128** to remove any identified inconsistencies. Alternatively, replacement **142** of part **128** with inconsistencies may be performed by maintenance entity **106**. Whether rework **140** or replacement **142** of part **128** with inconsistencies is appropriate in a particular situation may be defined by maintenance rules **135**.

In accordance with an illustrative embodiment, maintenance entity **106** may use maintenance device **146** to read identification information **126** for part **128** from automated identification technology tag **130** associated with part **128**. For example, without limitation, maintenance device **146** may be a portable device that is configured to read identification information **126** from automated identification technology tag **130**. Identification information **126** read from automated identification technology tag **130** may be sent from maintenance device **146** to aircraft network data processing system **122** on aircraft **102**. For example, without limitation, identification information **126** may be sent to aircraft network data processing system **122** from maintenance device **146** automatically in response to reading identification information **126** from automated identification technology tag **130** by maintenance device **146**. Alternatively, or in addition, a user may initiate the communication of identification information **126** from maintenance device **146** to aircraft network data processing system **122**.

Identification information **126** may be sent from maintenance device **146** to aircraft network data processing system **122** via communications link **148**. Communications link **148** may comprise any appropriate wired or wireless method for exchanging information between maintenance device **146** and aircraft network data processing system **122** on aircraft **102**. For example, without limitation, communications link **148** may be implemented using a secure Wi-Fi connection or other appropriate wireless or wired connection between maintenance device **146** and aircraft network data processing system **122**.

Aircraft network data processing system **122** may be configured to use identification information **126** received from maintenance device **146** to identify part information **124** stored onboard aircraft **102** for part **128** of aircraft **102** identified by identification information **126**. Part information **124** identified as corresponding to identification information **126** received from maintenance device **146** may be sent back to maintenance device **146**. For example, without limitation, part information **124** for part **128** may be identified and sent back to maintenance device **146** via communications link **148** automatically by aircraft network data processing system **122** in response to receiving identification information **126** from maintenance device **146**.

Part information **124** received by maintenance device **146** from aircraft network data processing system **122** on aircraft **102** may be used by maintenance entity **106** to perform maintenance operation **136** on part **128**. For example, part information **124** for part **128** received from aircraft network data processing system **122** may be displayed on maintenance device **146** for use by maintenance entity **106** to perform maintenance operation **136** on part **128**.

Maintenance entity **106** may use maintenance device **146** to send maintenance information **150** to aircraft network data processing system **122** on aircraft **102**. For example, maintenance device **146** may be configured to receive maintenance information **150** from maintenance entity **106**. Maintenance information **150** received from maintenance entity **106** then may be sent from maintenance device **146** to aircraft network data processing system **122** via communications link **148**.

Maintenance information **150** comprises information identifying maintenance operation **136** performed on part **128**. Maintenance operation **136** may change configuration **118** of aircraft **102**. In this case, maintenance information **150** sent to aircraft network data processing system **122** may

be used to change configuration information **120** so that configuration information **120** stored onboard aircraft **102** accurately identifies configuration **118** of aircraft **102** after maintenance operation **136** is performed. Maintenance information **150** received by aircraft network data processing system **122** may be used to update part information **124** stored onboard aircraft **102** for part **128**. For example, maintenance information **150** for part **128** received by aircraft network data processing system **122** may be used to update maintenance history information in part information **124** for part **128**.

Changing configuration information **120** in aircraft network data processing system **122** on aircraft **102** to include maintenance information **150** identifying maintenance operation **136** performed on part **128** forms updated configuration information **152**. Updated configuration information **152** identifies updated configuration **154** of aircraft **102**. Updated configuration **154** includes changes to configuration **118** of aircraft **102** resulting from maintenance operation **136** performed on part **128**. Changing configuration information **120** in aircraft network data processing system **122** to include maintenance information **150** may include changing part information **124** to include maintenance information **150**. Changing part information **124** to include maintenance information **150** identifying maintenance operation **136** performed on part **128** forms updated part information **156**. Updated configuration **154** becomes configuration **118** of aircraft **102**, updated configuration information **152** becomes configuration information **120**, and updated part information **156** becomes part information **124** for part **128** until configuration **118** of aircraft **102** is updated again by the performance of another maintenance operation **136** or in another appropriate manner.

Configuration information **120** stored onboard aircraft **102** may be used to generate configuration report **158** on aircraft **102**. Configuration report **158** may present configuration information **120** in any appropriate manner to identify configuration **118** of aircraft **102** onboard aircraft **102**. Because configuration information **120** onboard aircraft **102** may be updated promptly to reflect maintenance operation **136** performed on aircraft **102**, configuration report **158** provided on aircraft **102** will accurately identify configuration **118** of aircraft **102**. Configuration report **158** may be generated and displayed in any appropriate manner on aircraft **102**. For example, without limitation, configuration report **158** may be generated by aircraft network data processing system **122** and sent to maintenance device **146** for display on aircraft **102**.

Configuration information **120** stored on aircraft **102** may be sent to an appropriate location off-board aircraft **102** for analysis, display, or any other appropriate purpose. For example, without limitation, configuration information **120** may be sent from aircraft **102** to operator data processing system **160** located off-board aircraft **102**. Operator data processing system **160** may be any appropriate data processing system that is operated by or for aircraft operator **104** at a location on the ground or at any other appropriate location that is not on aircraft **102**. Configuration information **120** may be provided from aircraft network data processing system **122** on aircraft **102** to operator data processing system **160** via any appropriate network or other communications link.

Configuration information **120** may be sent from aircraft **102** to operator data processing system **160** periodically whenever an appropriate communications link from aircraft **102** to operator data processing system **160** may be established. For example, to ensure that the latest configuration information **120** is available on operator data processing system **160**, updated configuration information **152** may be sent from aircraft **102** to operator data processing system **160** whenever configuration information **120** is updated to include maintenance information **150** identifying maintenance operation **136** performed on aircraft **102**, if an appropriate communications link can be established between aircraft **102** and operator data processing system **160** at that time. If an appropriate communications link cannot be established at that time, updated configuration information **152** may be sent from aircraft network data processing system **122** to operator data processing system **160** off-board aircraft **102** when an appropriate communications link between aircraft **102** and operator data processing system **160** can be established.

Configuration information **120** from aircraft **102** that is stored in operator data processing system **160** may be used for any appropriate purpose. For example, without limitation, configuration information **120** stored in operator data processing system **160** may be used to generate configuration report **162** off-board aircraft **102**. Configuration report **162** may present configuration information **120** in any appropriate manner to identify configuration **118** of aircraft **102** off-board aircraft **102**.

The illustration of FIG. **1** is not meant to imply physical or architectural limitations to the manner in which different illustrative embodiments may be implemented. Other components in addition to, in place of, or both in addition to and in place of the ones illustrated may be used. Some components may be unnecessary in some illustrative embodiments. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined or divided into different blocks when implemented in different illustrative embodiments.

For example, aircraft network data processing system **122** may be configured to allow a user to access and change part information **124** stored on aircraft **102** without using maintenance device **146** or another device to read identification information **126** for part **128** from automated identification technology tag **130** associated with part **128** on aircraft **102**. For example, without limitation, a user interface for aircraft network data processing system **122** may be configured to allow a user to manually identify part **128** for which part information **124** stored on aircraft **102** may be retrieved or otherwise to search for part information **124** for part **128** that is stored in aircraft network data processing system **122** on aircraft **102**. The user interface for aircraft network data processing system **122** may be configured to display part information **124** for identified part **128** to the user in an appropriate manner for use, for example, in performing maintenance operation **136** on part **128**. The user interface for aircraft network data processing system **122** also may be configured to receive from the user maintenance information **150** identifying maintenance operation **136** performed on part **128** to update part information **124** stored onboard aircraft **102**. The user interface for aircraft network data processing system **122** also may be configured to display configuration report **158** that is generated by aircraft network data processing system **122** using configuration information **120** stored on aircraft **102**.

Turning now to FIG. **2**, an illustration of a block diagram of an aircraft is depicted in accordance with an illustrative embodiment. Aircraft **200** may be an example of one implementation of aircraft **102** in FIG. **1**.

Aircraft **200** is an example of vehicle **202**. Illustrative embodiments may be used for the maintenance of vehicle **202** other than aircraft **200**. Vehicle **202** may be any vehicle

configured for operation in the air, in space, on land, on water, under water, or in any other medium or combinations of media.

Vehicle **202** is an example of platform **204**. Illustrative embodiments may be used for the maintenance of platform **204** other than vehicle **202**. For example, platform **204** may be any fixed or mobile structure.

Aircraft **200** may include part **206**. Part **206** may include a number of various components of aircraft **200**. Part **206** may be located at any appropriate location on aircraft **200**.

Automated identification technology tag **238** may be associated with part **206** on aircraft **200**. Automated identification technology tag **238** may be active **239** or passive **240**. Active **239** automated identification technology tag **238** may be powered by an internal battery. Passive **240** automated identification technology tag **238** may operate without its own power source. For example, passive **240** automated identification technology tag **238** may obtain power from a reader when interrogated by the reader to read information from automated identification technology tag **238** or to write information to automated identification technology tag **238**.

Automated identification technology tag **238** may include radio frequency identification tag **241**, contact memory **242**, barcode **243**, or another appropriate type of automated identification technology tag. Radio frequency identification tag **241** uses radio frequency electromagnetic fields to transfer information when interrogated by a reader. The information stored in radio frequency identification tag **241** may be read from up to several yards away. Radio frequency identification tag **241** does not need to be within the line of sight of a reader to be interrogated. Therefore, for example, without limitation, radio frequency identification tag **241** may be imbedded in part **206** or in a structure of aircraft **200** near the location of part **206** on aircraft **200**.

Contact memory **242** also may be referred to as touch memory. Contact memory **242** is an electronic identification device that may be packaged in a button-shaped container. Information in contact memory **242** is accessed when a touch probe for a reader is brought into contact with contact memory **242**.

Barcode **243** is an optical machine-readable representation of information relating to part **206**. For example, barcode **243** may represent information relating to part **206** by varying widths and spacings of parallel lines. Alternatively, barcode **243** may represent information relating to part **206** using a two-dimensional pattern of rectangles, dots, hexagons, or other appropriate patterns or combinations of patterns.

Automated identification technology tag **238** may comprise single record tag **244**, dual record tag **245**, or multi record tag **246**. Single record tag **244** may be configured to store a relatively small amount of information thereon. For example, single record tag **244** may be configured to store less than approximately 2 kilobytes or another appropriate amount of information thereon. Furthermore, information stored on single record tag **244** may be locked so that the information stored on single record tag **244** may not be changed by writing to single record tag **244** when single record tag **244** is associated with part **206** on aircraft **200** or other vehicle **202**.

Dual record tag **245** also may be configured to store a relatively small amount of information thereon. For example, dual record tag **245** may be configured to store less than approximately 8 kilobytes or another appropriate amount of information thereon. Some of the information stored on dual record tag **245** may be locked. Other information stored on dual record tag **245** may be changed by writing to dual record tag **245** using an appropriate reader device when dual record tag **245** is associated with part **206** on aircraft **200** or other vehicle **202**. Dual record tag **245** may be relatively more expensive than single record tag **244**.

Multi record tag **246** may be configured to store a relatively large amount of information thereon. For example, multi record tag **246** may be configured to store more than approximately 8 kilobytes or another appropriate amount of information thereon. Some of the information stored on multi record tag **246** may be locked. However, most of the storage space on multi record tag **246** may be changed by writing to multi record tag **246** using an appropriate reader device when multi record tag **246** is associated with part **206** on aircraft **200** or other vehicle **202**. Multi record tag **246** may be relatively more expensive than single record tag **244** and dual record tag **245**.

In accordance with an illustrative embodiment, identification information **248** for part **206** may be stored on automated identification technology tag **238**. Identification information **248** may include any appropriate information identifying part **206** associated with automated identification technology tag **238**. Identification information **248** may comprise a relatively small amount of information. For example, without limitation, identification information **248** may be locked in automated identification technology tag **238** so that identification information **248** stored on automated identification technology tag **238** may not be changed by writing to automated identification technology tag **238** when automated identification technology tag **238** is associated with part **206** on aircraft **200** or other vehicle **202**.

Other information **250** also may be stored on automated identification technology tag **238** associated with part **206**. Other information **250** stored on automated identification technology tag **238** may include information describing various characteristics of part **206**. For example, without limitation, other information **250** stored on automated identification technology tag **238** may include information identifying maintenance operations performed on part **206**. Preferably, however, such maintenance history information for part **206** may be stored in a data processing system onboard aircraft **200** or other vehicle **202** so that such other information **250** need not be written to automated identification technology tag **238** when automated identification technology tag **238** is associated with part **206** on aircraft **200** or other vehicle **202**. Because a relatively small amount of identification information **248** may be stored on automated identification technology tag **238** and other information **250** need not be written to automated identification technology tag **238** when automated identification technology tag **238** is associated with part **206** on aircraft **200** or other vehicle **202**, automated identification technology tag **238** preferably may be implemented using less expensive single record tag **244** or dual record tag **245**.

Automated identification technology tag **238** may be attached to part **206** or to another structure on aircraft **200** or other vehicle **202** located near part **206** by attachment structure **254**. Attachment structure **254** may include any appropriate structure for attaching automated identification technology tag **238** to part **206** or to another structure on aircraft **200** or other vehicle **202**. For example, attachment structure **254** may include adhesive **256**, other attachment structure **258**, or a combination of structures for attaching automated identification technology tag **238** to part **206** or to another structure on aircraft **200** or other vehicle **202**. Attachment structure **254** may be tamper indicating **260**. For example, without limitation, radio frequency identification tag **241** may be provided with tear-off provisions built in the

tag so that when the tag is disturbed or damaged, the tag is disabled and rendered inoperative by the separation of the microchip from the antenna and packaging in radio frequency identification tag **241**.

Turning now to FIG. **3**, an illustration of a block diagram of a maintenance device is depicted in accordance with an illustrative embodiment. Maintenance device **302** may be an example of one implementation of maintenance device **146** in FIG. **1**. Maintenance device **302** may be configured to be used for maintaining part **304**. Part **304** may be an example of part **206** on aircraft **200** or other vehicle **202** in FIG. **2**.

Maintenance device **302** may be portable **306**. For example, without limitation, maintenance device **302** may be handheld **308**. Maintenance device **302** may include reader **310**, user interface generator **312**, communications unit **316**, and user interface devices **318**.

Automated identification technology tag **320** may be associated with part **304**. Identification information **322** for part **304** may be stored on automated identification technology tag **320**. Reader **310** may be configured to read identification information **322** from automated identification technology tag **320**. Reader **310** also may be configured to write information to automated identification technology tag **320**.

Identification information **322** may be provided from reader **310** to user interface generator **312**. User interface generator **312** may be configured to generate user interface **313** for displaying identification information **322** to user **348** on user interface devices **318**. User interface generator **312** also may be configured to generate user interface **313** for displaying part information **334** to user **348** on user interface devices **318**. User interface generator **312** also may be configured to generate user interface **313** configured for receiving maintenance information **336** from user **348**. User interface devices **318** may include display **350** for displaying information to user **348** and input device **352** for receiving input from user **348**.

Identification information **322** also may be provided from reader **310** to communications unit **316** for communication to onboard data processing system **338**. Onboard data processing system **338** may include processor unit **340** and storage device **342**. Part information **344** for part **304** may be stored in storage device **342**. Processor unit **340** may be configured to receive identification information **322** from maintenance device **302** and to use identification information **322** to identify and retrieve part information **344** for part **304** from storage device **342**. Part information **344** from onboard data processing system **338** may be sent back to maintenance device via communications unit **316**. Part information **344** received by communications unit **316** may be provided as part information **334** to user interface generator **312** for display to user **348** on user interface devices **318**. For example, without limitation, user **348** may use part information **334** to perform maintenance operation **346** on part **304**.

User **348** may enter maintenance information **336** into maintenance device **302** via user interface **313** and user interface devices **318**. Maintenance information **336** may identify maintenance operation **346** performed on part **304**. Maintenance information **336** may be sent to onboard data processing system **338** via communications unit **316**. Processor unit **340** may be configured to change part information **344** in storage device **342** to include maintenance information **336** for part **304**.

Alternatively, user **348** may obtain part information **344** for part **304** from onboard data processing system **338** via user interface **347** of onboard data processing system **338**. User **348** also may provide maintenance information **336** to onboard data processing system **338** via user interface **347**. Thus, part information **344** for part **304** may be retrieved for use by user **348** and updated to identify maintenance operation **346** performed on part **304** when maintenance device **302** is unavailable.

Maintenance device **302** also may be configured to send maintenance information **336** to off-board data processing system **324** via communications unit **316**. For example, without limitation, off-board data processing system **324** may be a data processing system operated by or for an operator of an aircraft or other vehicle comprising part **304**. Communications unit **316** may be configured to send maintenance information **336** and other information to off-board data processing system **324** at any appropriate time via wireless connection **326**. Alternatively, or in addition, communications unit **316** may be configured to send maintenance information **336** and other information to off-board data processing system **324** via docking station **328** when maintenance device **302** is placed in docking station **328**. Docking station **328** may be connected to off-board data processing system **324** via connection **330**. Connection **330** may be a wired or wireless connection.

Maintenance device **302** may be a battery powered device. In this case, docking station **328** also may be configured to operate as charger **332** for charging a battery in maintenance device **302** when maintenance device **302** is placed in docking station **328**.

The illustration of FIG. **3** is not meant to imply physical or architectural limitations to the manner in which different illustrative embodiments may be implemented. Other components in addition to, in place of, or both in addition to and in place of the ones illustrated may be used. Some components may be unnecessary in some illustrative embodiments. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined or divided into different blocks when implemented in different illustrative embodiments.

Turning now to FIG. **4**, an illustration of a block diagram of configuration information is depicted in accordance with an illustrative embodiment. Configuration information **400** may be an example of configuration information **120** for aircraft **102** in FIG. **1**.

For example, without limitation, configuration information **400** may include part information **402** for a part of the configuration described by configuration information **400**. Part information **402** may include identification information **404**, manufacturer information **406**, date of manufacture information **408**, expiration date **410**, location information **412**, maintenance history information **414**, and other information **416**.

Identification information **404** may include one or more of part number **418** and serial number **420** for a part. Identification information **404**, manufacturer information **406**, and date of manufacture information **408** may comprise birth record **421** for the part.

Maintenance history information **414** may include maintenance information **422** identifying each time that a maintenance operation is performed on a part. For example, without limitation, maintenance information **422** may identify maintenance entity **424** that performed the maintenance operation, maintenance date **426** when the maintenance operation was performed, type of maintenance **428** that was performed during the maintenance operation, other maintenance information **430**, or various combinations of information identifying a maintenance operation performed on a part.

Turning now to FIG. **5**, an illustration of a flowchart of a process for maintaining a vehicle is depicted in accordance with an illustrative embodiment. Process **500** may be implemented, for example, using maintenance device **146** in FIG. **1** or maintenance device **302** in FIG. **3**.

Process **500** may begin by reading identification information for a part from an automated identification technology tag associated with the part (operation **502**). The identification information then may be sent to an onboard data processing system that is on the aircraft or other vehicle comprising the part (operation **504**). Part information for the part may be received from the onboard data processing system (operation **506**). The received part information may be displayed to a user (operation **508**). The user may use the displayed part information to perform a maintenance operation on the part (operation **510**). Maintenance information identifying the maintenance operation performed may be sent to the onboard data processing system (operation **512**). Maintenance information identifying the maintenance operation also may be sent to an off-board data processing system (operation **514**), with the process terminating thereafter.

Turning now to FIG. **6**, an illustration of a flowchart of another process for maintaining a vehicle is depicted in accordance with an illustrative embodiment. For example, process **600** may be implemented in aircraft network data processing system **122** on aircraft **102** in FIG. **1** or in onboard data processing system **338** in FIG. **3**.

Process **600** begins by storing part information in an onboard data processing system (operation **602**). It then may be determined whether identification information for a part is received (operation **604**). Operation **604** may be repeated until it is determined that identification information for a part is received. When identification information for a part is received, part information for the part is retrieved from the onboard data processing system using the identification information (operation **606**). The retrieved part information may be displayed to a user (operation **608**).

It then may be determined whether maintenance information identifying a maintenance operation performed on a part is received (operation **610**). If maintenance information is not received, the process may terminate. If maintenance information is received, the part information in the onboard data processing system may be changed to include the maintenance information (operation **612**). The updated part information then may be sent to an off-board data processing system (operation **614**), with the process terminating thereafter.

Turning now to FIG. **7**, an illustration of a block diagram of a data processing system is depicted in accordance with an illustrative embodiment. Data processing system **700** may be an example of one implementation of a data processing system for implementing aircraft network data processing system **122** or maintenance device **146** in FIG. **1**.

In this illustrative example, data processing system **700** includes communications fabric **702**. Communications fabric **702** provides communications between processor unit **704**, memory **706**, persistent storage **708**, communications unit **710**, input/output unit **712**, and display **714**. Memory **706**, persistent storage **708**, communications unit **710**, input/output unit **712**, and display **714** are examples of resources accessible by processor unit **704** via communications fabric **702**.

Processor unit **704** serves to run instructions for software that may be loaded into memory **706**. Processor unit **704** may be a number of processors, a multi-processor core, or some other type of processor, depending on the particular implementation. Further, processor unit **704** may be implemented using a number of heterogeneous processor systems in which a main processor is present with secondary processors on a single chip. As another illustrative example, processor unit **704** may be a symmetric multi-processor system containing multiple processors of the same type.

Memory **706** and persistent storage **708** are examples of storage devices **716**. A storage device is any piece of hardware that is capable of storing information, such as, for example, without limitation, data, program code in functional form, and other suitable information either on a temporary basis or a permanent basis. Storage devices **716** also may be referred to as computer readable storage devices in these examples. Memory **706**, in these examples, may be, for example, a random access memory or any other suitable volatile or non-volatile storage device. Persistent storage **708** may take various forms, depending on the particular implementation.

For example, persistent storage **708** may contain one or more components or devices. For example, persistent storage **708** may be a hard drive, a flash memory, a rewritable optical disk, a rewritable magnetic tape, or some combination of the above. The media used by persistent storage **708** also may be removable. For example, a removable hard drive may be used for persistent storage **708**.

Communications unit **710**, in these examples, provides for communications with other data processing systems or devices. In these examples, communications unit **710** is a network interface card. Communications unit **710** may provide communications through the use of either or both physical and wireless communications links.

Input/output unit **712** allows for input and output of data with other devices that may be connected to data processing system **700**. For example, input/output unit **712** may provide a connection for user input through a keyboard, a mouse, and/or some other suitable input device. Further, input/output unit **712** may send output to a printer. Display **714** provides a mechanism to display information to a user.

Instructions for the operating system, applications, and/or programs may be located in storage devices **716**, which are in communication with processor unit **704** through communications fabric **702**. In these illustrative examples, the instructions are in a functional form on persistent storage **708**. These instructions may be loaded into memory **706** for execution by processor unit **704**. The processes of the different embodiments may be performed by processor unit **704** using computer-implemented instructions, which may be located in a memory, such as memory **706**.

These instructions are referred to as program instructions, program code, computer usable program code, or computer readable program code that may be read and executed by a processor in processor unit **704**. The program code in the different embodiments may be embodied on different physical or computer readable storage media, such as memory **706** or persistent storage **708**.

Program code **718** is located in a functional form on computer readable media **720** that is selectively removable and may be loaded onto or transferred to data processing system **700** for execution by processor unit **704**. Program code **718** and computer readable media **720** form computer program product **722** in these examples. In one example, computer readable media **720** may be computer readable storage media **724** or computer readable signal media **726**.

Computer readable storage media **724** may include, for example, an optical or magnetic disk that is inserted or placed into a drive or other device that is part of persistent storage **708** for transfer onto a storage device, such as a hard

drive, that is part of persistent storage **708**. Computer readable storage media **724** also may take the form of a persistent storage, such as a hard drive, a thumb drive, or a flash memory, that is connected to data processing system **700**. In some instances, computer readable storage media **724** may not be removable from data processing system **700**.

In these examples, computer readable storage media **724** is a physical or tangible storage device used to store program code **718** rather than a medium that propagates or transmits program code **718**. Computer readable storage media **724** is also referred to as a computer readable tangible storage device or a computer readable physical storage device. In other words, computer readable storage media **724** is a media that can be touched by a person.

Alternatively, program code **718** may be transferred to data processing system **700** using computer readable signal media **726**. Computer readable signal media **726** may be, for example, a propagated data signal containing program code **718**. For example, computer readable signal media **726** may be an electromagnetic signal, an optical signal, and/or any other suitable type of signal. These signals may be transmitted over communications links, such as wireless communications links, optical fiber cable, coaxial cable, a wire, and/or any other suitable type of communications link. In other words, the communications link and/or the connection may be physical or wireless in the illustrative examples.

In some illustrative embodiments, program code **718** may be downloaded over a network to persistent storage **708** from another device or data processing system through computer readable signal media **726** for use within data processing system **700**. For instance, program code stored in a computer readable storage medium in a server data processing system may be downloaded over a network from the server to data processing system **700**. The data processing system providing program code **718** may be a server computer, a client computer, or some other device capable of storing and transmitting program code **718**.

The different components illustrated for data processing system **700** are not meant to provide architectural limitations to the manner in which different embodiments may be implemented. The different illustrative embodiments may be implemented in a data processing system including components in addition to and/or in place of those illustrated for data processing system **700**. Other components shown in FIG. **7** can be varied from the illustrative examples shown. The different embodiments may be implemented using any hardware device or system capable of running program code. As one example, data processing system **700** may include organic components integrated with inorganic components and/or may be comprised entirely of organic components excluding a human being. For example, a storage device may be comprised of an organic semiconductor.

In another illustrative example, processor unit **704** may take the form of a hardware unit that has circuits that are manufactured or configured for a particular use. This type of hardware may perform operations without needing program code to be loaded into a memory from a storage device to be configured to perform the operations.

For example, when processor unit **704** takes the form of a hardware unit, processor unit **704** may be a circuit system, an application specific integrated circuit (ASIC), a programmable logic device, or some other suitable type of hardware configured to perform a number of operations. With a programmable logic device, the device is configured to perform the number of operations. The device may be reconfigured at a later time or may be permanently configured to perform the number of operations. Examples of programmable logic devices include, for example, a programmable logic array, a programmable array logic, a field programmable logic array, a field programmable gate array, and other suitable hardware devices. With this type of implementation, program code **718** may be omitted, because the processes for the different embodiments are implemented in a hardware unit.

In still another illustrative example, processor unit **704** may be implemented using a combination of processors found in computers and hardware units. Processor unit **704** may have a number of hardware units and a number of processors that are configured to run program code **718**. With this depicted example, some of the processes may be implemented in the number of hardware units, while other processes may be implemented in the number of processors.

In another example, a bus system may be used to implement communications fabric **702** and may be comprised of one or more buses, such as a system bus or an input/output bus. Of course, the bus system may be implemented using any suitable type of architecture that provides for a transfer of data between different components or devices attached to the bus system.

Additionally, communications unit **710** may include a number of devices that transmit data, receive data, or both transmit and receive data. Communications unit **710** may be, for example, a modem or a network adapter, two network adapters, or some combination thereof. Further, a memory may be, for example, memory **706**, or a cache, such as that found in an interface and memory controller hub that may be present in communications fabric **702**.

The flowcharts and block diagrams described herein illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various illustrative embodiments. In this regard, each block in the flowcharts or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function or functions. It should also be noted that, in some alternative implementations, the functions noted in a block may occur out of the order noted in the figures. For example, the functions of two blocks shown in succession may be executed substantially concurrently, or the functions of the blocks may sometimes be executed in the reverse order, depending upon the functionality involved.

The description of the different illustrative embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or to limit the embodiments in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. Further, different illustrative embodiments may provide different benefits as compared to other illustrative embodiments. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method of maintaining a vehicle, comprising:

reading identification information for a part on the vehicle from an automated identification technology tag by a maintenance device, wherein the automated identification technology tag is on the vehicle and associated with the part;

sending the identification information for the part that is read from the automated identification technology tag

from the maintenance device to an onboard data processing system on the vehicle;

receiving the identification information for the part sent from the maintenance device by the onboard data processing system on the vehicle;

using the identification information for the part received from the maintenance device by the onboard data processing system on the vehicle to identify and retrieve part information for the part from a storage device on the vehicle;

sending the part information for the part retrieved from the storage device on the vehicle from the onboard data processing system to the maintenance device;

receiving the part information for the part by the maintenance device from the onboard data processing system on the vehicle, wherein the part information for the part includes maintenance history information for the part;

displaying the part information received from the onboard data processing system to a user on the maintenance device;

using the part information displayed on the maintenance device to perform a maintenance operation on the part; and

sending maintenance information identifying the maintenance operation performed on the part to the onboard data processing system.

2. The method of claim **1**, wherein the automated identification technology tag is selected from a radio frequency identification tag, a contact memory, and a bar code.

3. The method of claim **1**, wherein the automated identification technology tag comprises

a single record tag, wherein information stored on the single record tag is locked so that the information stored on the single record tag cannot be changed by writing to the single record tag when the single record tag is on the vehicle and associated with the part.

4. The method of claim **1**, wherein the automated identification technology tag is attached to the part.

5. The method of claim **1**, wherein:

the identification information for the part is selected from a part number for the part and a serial number for the part.

6. The method of claim **1** further comprising:

changing the part information for the part in the storage device on the vehicle to form updated part information for the part including the maintenance information identifying the maintenance operation performed on the part.

7. The method of claim **6**, wherein the maintenance device is portable and is connected to the onboard data processing system via a communications link.

8. The method of claim **1** further comprising:

sending the maintenance information identifying the maintenance operation performed on the part from one of the onboard data processing system and the maintenance device to an off-board data processing system that is not on the vehicle.

9. The method of claim **1**, wherein the vehicle is an aircraft and the onboard data processing system is an aircraft network data processing system on the aircraft.

10. An apparatus, comprising:

a maintenance device that is configured to read identification information for a part on a vehicle from an automated identification technology tag and to send the identification information for the part that is read from the automated identification technology tag to an onboard data processing system on the vehicle, wherein the maintenance device comprises a user interface and wherein the automated identification technology tag is on the vehicle and associated with the part;

a storage device on the vehicle; and

the onboard data processing system on the vehicle comprising a processor unit on the vehicle, wherein the onboard data processing system on the vehicle is configured to receive the identification information for the part sent from the maintenance device, use the identification information for the part received from the maintenance device to identify and retrieve part information for the part from the storage device on the vehicle, wherein the part information for the part includes maintenance history information for the part stored on the storage device on the vehicle, send the part information for the part retrieved from the storage device on the vehicle to the maintenance device for display on the user interface, receive maintenance information identifying a maintenance operation performed on the part, and store the maintenance information identifying the maintenance operation performed on the part on the storage device on the vehicle.

11. The apparatus of claim **10**, wherein the automated identification technology tag is selected from a radio frequency identification tag, a contact memory, and a bar code.

12. The apparatus of claim **10**, wherein the automated identification technology tag is

a single record tag, wherein information stored on the single record tag is locked so that the information stored on the single record tag cannot be changed by writing to the single record tag when the single record tag is on the vehicle and associated with the part.

13. The apparatus of claim **10**, wherein the automated identification technology tag is attached to the part.

14. The apparatus of claim **10**, wherein:

the identification information for the part is selected from a part number for the part and a serial number for the part.

15. The apparatus of claim **10**, wherein the onboard data processing system on the vehicle is further configured to:

change the part information for the part in the storage device on the vehicle to form updated part information for the part including the maintenance information identifying the maintenance operation performed on the part.

16. The apparatus of claim **15**, wherein the onboard data processing system on the vehicle is further configured to send the updated part information for the part to an off-board data processing system that is not on the vehicle.

17. The apparatus of claim **10**, wherein the vehicle is an aircraft and the onboard data processing system on the vehicle comprises an aircraft network data processing system on the aircraft.

18. A method of maintaining an aircraft, comprising:

reading identification information for a part on the aircraft from an automated identification technology tag by a maintenance device, wherein the automated identification technology tag is on the aircraft and associated with the part;

sending the identification information for the part that is read from the automated identification technology tag from the maintenance device to an aircraft network data processing system on the aircraft;

receiving the identification information for the part sent from the maintenance device by the aircraft network data processing system on the aircraft;

using the identification information for the part received from the maintenance device by the aircraft network data processing system on the aircraft to identify and retrieve part information for the part from a storage device on the aircraft, wherein the part information for the part includes maintenance history information for the part;

sending the part information for the part retrieved from the storage device on the aircraft by the aircraft network data processing system on the aircraft to the maintenance device for display to a user;

receiving maintenance information for the part by the aircraft network data processing system, wherein the maintenance information identifies a maintenance operation performed on the part;

changing the part information in the storage device by the aircraft network data processing system in response to receiving the maintenance information to form updated configuration information including the maintenance information; and

sending the updated configuration information to an off-hoard data processing system that is not on the aircraft by the aircraft network data processing system.

19. The method of claim **18** further comprising:

receiving, by the maintenance device, the part information from the aircraft network data processing system;

displaying the part information received from the aircraft network data processing system on a user interface on the maintenance device;

receiving, by the maintenance device, the maintenance information for the part from the user; and

sending the maintenance information for the part from the maintenance device to the aircraft network data processing system.

* * * * *